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HIGH CAPACITY SATELLITE COMMUNICATIONS - COST-EFFECTIVE BANDWIDTH TECHNOLOGY

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ABSTRACT

"As the demand for service increases in the future, the cost of COMSAT services purchased by DISA is projected to grow to $3B-$5B over the next 15 years. This growth will cost DoD precious dollars during a period of tightening budgets if DoD does not change its current approach to procuring COMSAT services."[1]

"Service providers around the world share concerns about running out of bandwidth. Business challenges surrounding continued bandwidth growth, linked to video, mobility, and cloud applications, are significant. Service providers also report declining revenue from a cost-per-bit perspective, so not only does the network need to grow; it also needs to grow more cost effectively."[2]

Why do DoD and the Broadband Industry have such opposing views: Demand Increases and Cost Increases versus Growing Broadband Demand, more Efficient Networking, and Lowering Cost of the Delivered Bit? Simply stated, Commercial Broadband Industry recognizes, embraces, and focusses on serving the growing broadband demand with ever more efficient end-to-end networking, from a cost-per-bit perspective, while the DoD's multiple acquisitions authorities, such as US AFSPC and DISA for WGS/leased Ku-band bandwidth, and PEO C3T, SPAWAR, and DISA for satellite networking, oppose an end-to-end approach focused on end-to-end performance and efficiency and continue to buy what has now become the most expensive, lowest performance satellite communication solutions.

By continuing existing acquisition approaches that are focused on individual acquisition authority component performance versus end-to-end performance, the future of increasing costs portrayed by the Defense Business Board (DBB) is inevitable. However, with a change to end-to-end networking view, DoD could leverage the investments and continually improvements of the Broadband Industry, increasing mission performance, eliminating this cost growth, and retaining military dominance.

HIGH CAPACITY SATELLITE (HCS) COMMUNICATIONS - COST-EFFECTIVE BROADBAND

This paper looks at DoD's satellite communication (Satcom) with respect to existing DoD Wideband Satcom, namely WGS and leased commercial Ku-band, and compares DoD Satcom with modern broadband technologies, namely High Capacity Satellites (HCS), that provide cost-effective bandwidth options to meet the Department's growing communications requirements.

Today, a single satellite, ViaSat-1, with 140 Gbps[3] of capacity and a cost well below $0.5B, has more on-orbit communication capacity than the entire DoD, including WGS[4], AEHF[5], and MUOS[6], plus the 51 satellites of the

commercial broadcast market leader, Intelsat, combined at a combined cost exceeding $35B, as shown in Exhibit 1.* So, how did this happen and what does this mean for affordable satellite communications and military dominance?

It happened because, for the first time, satellites are purposely designed to meet the requirements of Broadband and not for general purpose Fixed Satellite Services (FSS) that are dominated by Broadcast services. The distinctive attribute of broadband is that it is designed to deliver different information to/from each subscriber, while broadcast is designed to deliver the same information to every subscriber. This important distinction means that new end-to-end Satcom systems have become available that can dramatically improve mission performance, provide greater resilience, and improve affordability with respect to a broadband context – which is much different than adapting a broadcast asset to emerging commercial and DoD broadband applications, and absorbing the significant inherent inefficiencies in performance and affordability in the process. HCS, like ViaSat-1, are specifically designed to optimize the economics of two-way broadband communication, meaning maximizing the amount of user speed and capacity, or pool of bits, that are generated for a given total end-to-end investment including satellite, launch, insurance, ground segment and operations.

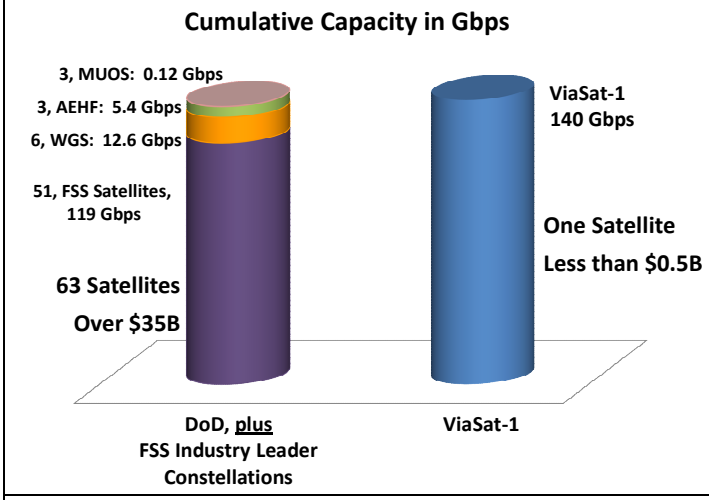


Exhibit 1: With ViaSat-1's Speed, Capacity, and Affordability performance, Satellite Broadband became a viable alternative to terrestrial Broadband service.

Today, while the pool of bits generated for the WGS investment remain constant, the current generation of HCS, exhibiting 50-fold improvement over WGS, can be applied to improved mission performance, affordability, or both. And new generations of HCS, which will be in service before the planned FY16/17 DoD Wideband Satcom Analysis of Alternatives (AoA) completes will exhibit greater than 100-fold improvements over WGS with the promise to continue that improvement with each new generation.

To understand this significant difference, you need to consider what satellites do. In this analysis it will become clear the satellites used for DoD Wideband Satcom, namely WGS and leased commercial Ku-band, were constructed with attributes enabling "Broadcast" efficiencies. These "Broadcast" attributes optimize delivering of the same bit or channel, i.e. live event or Global Broadcast System (GBS) video feed, across a broad geographic area. Contrasting, HCS are constructed with attributes enabling "Broadband" efficiencies. These "Broadband" attributes optimize the cost of each delivered bit, since each end user or subscriber has individual content.

In either the terrestrial or satellite Broadband business model, each subscriber consumes an individual portion of the terrestrial or satellite network infrastructure and over time their individual consumption increases due to their demand for increasing speed and capacity linked to video, mobility, and cloud applications. As the speeds and capacity offered are increased, this causes the number of subscribers served by any generation of networking

* 6, WGS 12.6 Gbps/$2.3B; 3, AEHF 5.4Gbps/$13.2B; 3, MUOS .12Gbps/$3.7B; and Intelsat 118.8Gbps/$15.3B

technology to decline and fuels the business challenge to serve continued broadband growth with more cost efficient networking, from a cost-per-bit perspective, with each generation networking technology.

This important Broadband business concept is directly applicable to DoD's use of both military and commercial Satcom, due to both increasing numbers of DoD subscribers, serving lower echelons, and increasing usage per DoD end-user or mission.

EVALUATING SATELLITE ECONOMICS

When determining how to evaluate Satcom for Broadband a key metric to consider is what you get in "capacity or bits" for a given investment. There are many ways to determine this, but the simplest would be to take the system costs and divide by what it provides. Basically, the total dollars, including satellite, launch, and insurance (if applicable) divided by capacity, or pool of bits. As shown in Exhibit 2, we display this as millions of dollars per gigabit per second or $Millions / Gbps.

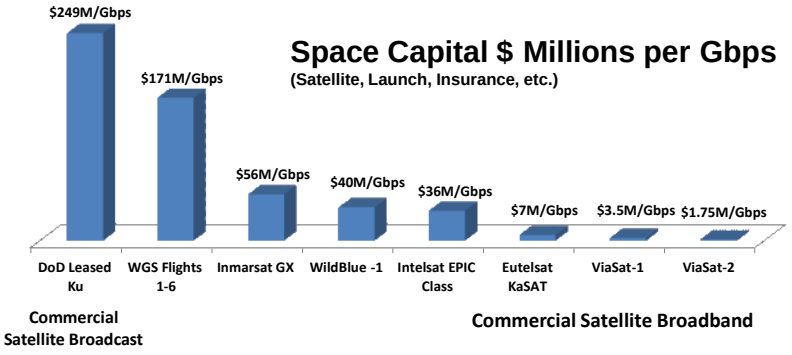


Exhibit 2: The actual cost to generate "capacity or bits" is trending down significantly with each generation of commercial satellite broadband.

The Commercial Ku-band fixed satellite services that the DoD typically leases has the highest cost of space segment capacity at $249M/Gbps.[†] This is followed by WGS with a cost of space segment capacity at $171/Gbps.[‡]

This can be contrasted by the space segment capacity costs of 1st generation HCS including Inmarsat GX, WildBlue-1, and Intelsat Epic[7, 8] that are in the range of $35-55M/Gbps representing a 3 to 5-fold cost of space segment capacity improvement over WGS.[§, **]

Finally there are the 2nd and 3rd generation HCS represented by ViaSat-1 and ViaSat-2 that have reported space segment capacity costs of $3.5 and $1.75M/Gbps respectively, representing a 50 to 100-fold cost of space segment capacity improvement over WGS.

Considering any generation of HCS, the DoD could realize significant multi-fold affordability improvements over currently leased Ku-band, even when considering multi-year leases that could net 10-15% reductions, or WGS.

Other ways to determining how to evaluate Satcom for Broadband would be to look at the actual Book Value of the commercial Satcom systems or even what customer's pay (i.e. revenue) as reported in the commercial

[†] Commercial Ku-band: Per satellite average of 35, 36MHz transponders, at 1.5 bits/Hz, and average cost of $470M including satellite at $300M, launch at $120M, and insurance at 12%

[‡] WGS: Highest reported capacity of 3.5 Gbps and a cost of $600M including satellite at $377M and Delta launch at $223M

[§] Inmarsat GX: 3, satellites with a reported capacity of 7.5Gbps each and an investment cost reported of $1.2B

[**] Intelsat EPIC: Reported 270 equivalent 36MHz transponders at 1.5 bits/Hz and cost of $604.8M including satellite at $420M, launch at $120M, and insurance at 12%

corporation's earnings releases. These evaluations in Exhibit 3 and 4 based on 4th calendar quarter 2014 earnings releases for Intelsat[9], SES[10], Eutelsat[11], and ViaSat[12] show the average value or revenue earned from the respective on-orbit fleets in $M/Gbps. In these exhibits, it is clearly visible that the HCS fleet-wide book value is considerably less than commercial FSS fleets. This improved affordability advantage is being be used to address markets that couldn't be addressed by the commercial FSS fleets, like direct-to-home broadband internet where Pricing, Speeds and Capacity must be comparable to terrestrial broadband services. This affordability advantage could be used by the DoD to improve their mission speed, capacity, and AJ performance while also improving affordability.

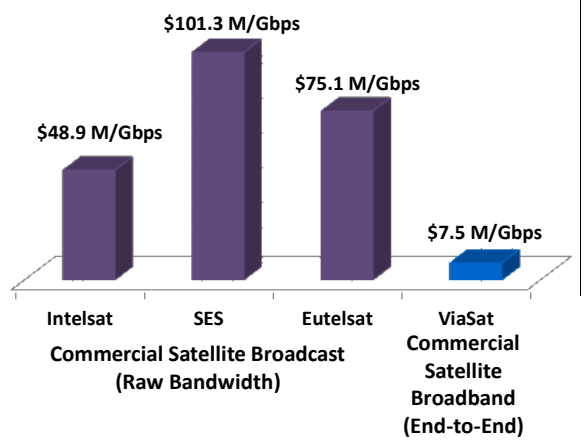


Exhibit 3: End-to-end service providers like ViaSat are driven to improve capacity efficiency to meet the growing demands of the broadband customer base.

It is important to note that the business model for commercial satellite broadcast and broadband differ in that the commercial satellite broadcast capacity is typically sold "undressed" meaning without the additional cost of backhaul and networking to complete an end-to-end satellite communication system. In general the cost of backhaul and networking is considered to be on par with the cost of the satellites themselves. This is how the DoD leases this capacity today, without backhaul and networking. Thus, the book value and revenue numbers for Intelsat, SES, and Eutelsat do not include the additional cost of backhaul and networking and as such are understated, likely by a factor of 2 or more, when compared to the end-to-end networking cost including in the ViaSat metrics.

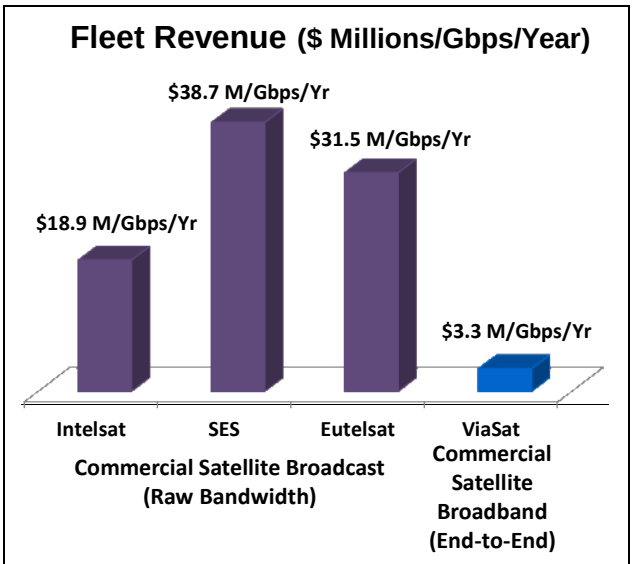


Exhibit 4: The lower capacity economics enables commercial satellite broadband to become a terrestrial broadband equivalent in service delivery and price.

To bring these fleet-wide revenue evaluations into a Transponder Equivalent (TPE) model, DoD would express average cost per TPE in the range of $2M/TPE/Year. The total annualized revenue of Intelsat, SES, and Eutelsat is $6.3B with a combined transponder capacity of 4,348 TPEs. Thus, their industry average revenue per transponder, based on these 4th calendar quarter reports, is $1.5M/TPE/Year, which considering that it is a mix of 15-year, multi-year, annual and spot market leases, is quite comparable to DoD's figure of $2M/TPE/Year.

The concluding thought with evaluating satellite economics isn't really about affordability or what DoD is paying for satellite broadband. DoD can continue to lease commercial Ku-band at rates between $1.5M to $2M/TPE/Year via annual or even multi-year acquisitions and not see appreciable savings because that is what these systems cost. DoD can continue to build and deploy WGS flights 10 and beyond and not see appreciable

savings because that is what these systems cost. And as forecasted by the Defense Business Board (DBB), total annual budget dollars will need to increase as demand increases since the cost of this capacity stays constant.

The concluding thought is actually mission performance and decisive warfighter advantage or what DoD gets for its money. Is it right for each passenger on a JetBlue airlines flight to have better broadband than our senior leaders have on their aircraft? Is it right for a family on the "freedom" plan receiving a 12 by 3 Mbps unlimited rate service, to have better satellite broadband than a US Navy Aircraft Carrier? If the DoD is going to spend $260K per month to provision satellite broadband for Air Force One or even an Aircraft Carrier, they should receive the mission performance commensurate with HCS services.[††]

CAPACITY DEMAND AND SPEEDS WILL CONTINUE TO INCREASE

To participate in the mainstream of mission performance, requires keeping pace with rapid growing broadband demand for both Speed and Capacity. This means that a satellite designed for today's demand will be obsolete before it is launched. Estimates of capacity demand must take into account the explosive growth in the demand for broadband speeds and capacity. Most experts assume that capacity demand doubles in terms of speed and capacity required every 18 to 48 months. In 2014 alone, Cisco's Visual Networking Index circa 3 Feb 2015 reported global mobile data traffic grew 69 percent and mobile network connection speeds grew 20 percent.[13] They also reported that smartphones represent only 29 percent of total global handsets in use in 2014, but these phones represent 69% of the total global handset traffic. These smartphones generated 37 times more mobile data traffic (819 MB per month) than the typical basic-feature cell phone (which generated only 22 MB per month of mobile data traffic). What is the demand going to be when the smartphone generation becomes the "E5s" of our military? As our warfighters begin to deploy 4G/LTE devices on the battlefield; in applications such as body worn tactical cameras, biometric scanners and tactical medical devices enabling personal health and status monitoring, and access to remote medical resources; these broadband bandwidth demands will continue to grow with the average Personal Electronic Device (PED) operated at 1Mbps in 2013, reaching 2Mbps in 2016, and 4Mbps in 2019.

This point is evidenced by DoD long and short term growth rates. DoD has reported its own long term growth from 2002-2011 at 34% annually.[14] The short term growth rate has been as high as 69%, as shown in Exhibit 5, looking at the actual capacity increase that DoD experienced in OEF/OIF.[15] This data clearly shows there has been a dramatic increase in DoD's required broadband capacity going from 2.3 Gbps in March 2008 to 31.6 Gbps in the summer of 2012. All of this is driven by increasing market expectations, new applications, improved mission performance and the need for decisive warfighter advantage. This is further demonstrated by the 84% annual average growth rate in ISR missions and resulting video and sensor capacity both ex-filtrated and reinserted into theater, as shown in Exhibit 6.

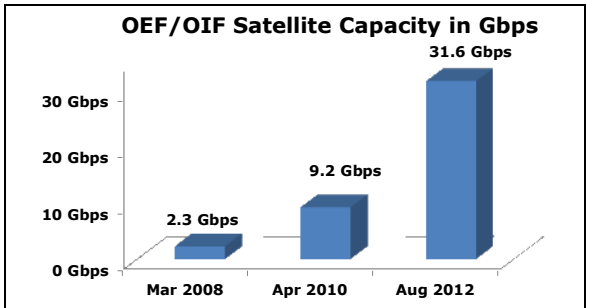


Exhibit 5: DoD demand for increased Speeds and Capacity parallels demand growth in the commercial market driven by continual improvements in computers, tablets, smartphones and applications.

[††] BBSN senior leader satellite services, $54M annually for 17 senior leader aircraft (averaging $260K/Aircraft/Year)

So how do these HCS address this increasing demand? The two-way broadband commercial Satcom business is an end-to-end business ecosystem where ViaSat and others are investing significant space and ground segment capital and holding these capital assets over a 15-year life (nominal satellite service life). To be successful, they must do this in an environment where the customer's demand, or consumption of capacity, is arguably doubling every 18-48 months without a commensurate increase in service revenues. The commercial business model is that in computers; smartphones; and fixed, wireless, mobile, and satellite broadband communications, customers are demanding more and consuming more capacity without a comparable increase in fees. Since customers are demanding more for less, commercial business factors and the resulting technology innovations are supporting and further enabling this business model to the benefit of all concerned.

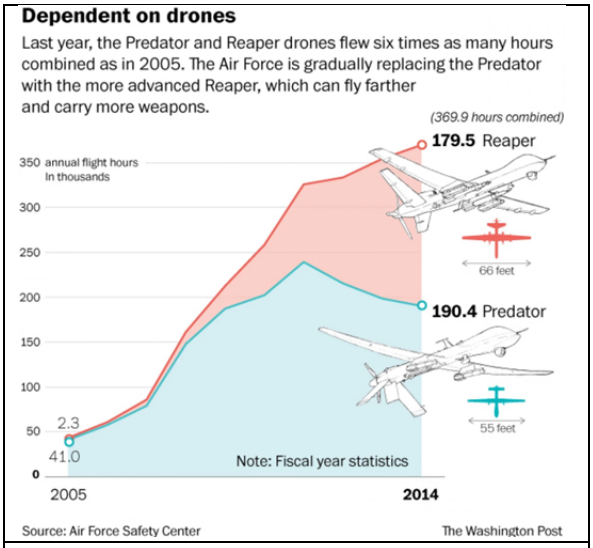


Exhibit 6: DoD demand for increased Speeds and Capacity is not driving by the requirements process; instead it is driven by market expectations, new applications, and mission performance for retaining military dominance.

Satellite communications has historically been viewed as "the service of last resort", meaning that it's the form of communication to use when there is no alternative. This traditional view, driven by the cost economics of commercial Ku-band and even WGS, has become sorely outdated. The emerging and correct view is that satellite communications can compete very effectively in the mainstream with terrestrial broadband – substantiated by the finding in the FCC benchmark report, stating that ViaSat's "Exede® internet service is superior to all other consumer broadband offerings in the US including cable, DSL and FTTH in meeting or exceeding promised speeds" (12 Mbps to the home and 3 Mbps return) which fully validates this emerging perspective.[16]

A fundamental to providing a broadband service that exceeds expectations is not only having sufficient capacity that the network is not in congestion or oversubscribed in the busy hour, but it also has a cost of capacity enabling this to be done affordably with respect to other market alternatives. Our business is committed to providing satellite broadband that achieves terrestrial broadband performance today and tomorrow. Our brand, Exede® Internet, reflects this commitment to the user experience. To achieve this, we cannot allow congestion and oversubscription at any busy hour, and we strive to do this continuously. It would be presumptuous to say congestion will never occur; just remember iPhone introduction and Times Square. But, ViaSat-2 represents our commitment to continue to build on our network, achieving new levels of broadband user experience, now defined by the FCC as 25 X 3 Mbps, to the at-home, at-office or in-flight market segments.

ViaSat's satellite broadband network has capacity to serve 2.4 exabytes daily and current usage is about 400 terabytes daily, serving over 2 million personal devices connected daily. To put 400 terabytes in perspective, if a single 36MHz FSS transponder was fully loading 24/7/365, it would take almost 2 years to send 400 terabytes.[‡‡] Our service has the capacity and cost of capacity, measured in $M/Gbps, to not depend on oversubscription or to disserve our customers by not achieving terrestrial speed, capacity, and price performance as demonstrated by our current market performance.

[‡‡] 36MHz with 1.5bits/Hz generating 54 Mbps or 0.58 terabytes/day

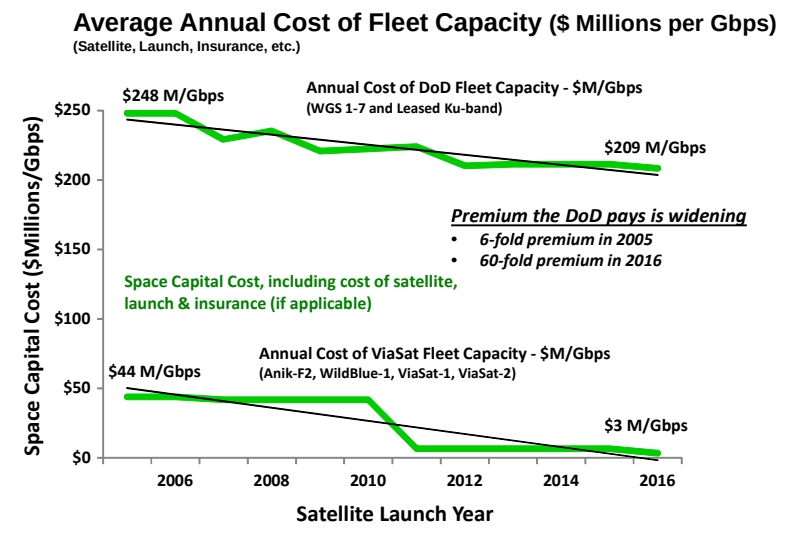
As shown above, commercial leased Ku-band and even WGS networks would need to resort to oversubscribing and congestion when balancing budget affordability with available capacity and the cost of that capacity. This is driven by lack of sufficient network capacity and the high cost of that capacity. To commit to properly operating a network without congestion, depends on a capacity cost that does not require oversubscription to fund the network not only today, but also tomorrow.

In the timeframe of the planned FY16/17 DoD Wideband Satcom AoA, ViaSat will add Caribbean and North Atlantic regions, expand the North American and European regions, and expand its overall network capacity by 250%. With ViaSat-2, already in production, and our next generation of HTS, already in design, we are continuing to innovate in the direction of speed, coverage and capacity economics since these parameters are emerging as the keys to being a successful broadband commercial Satcom service provider.

THE GAP CONTINUES TO INCREASE

Our views are driven from our on-orbit capacity, on-orbit satellites, and thought leadership in the HCS segment. While many in the industry are in production of their first generation of HCS, ViaSat is already working on our 4th generation. Our 1st generation Anik-F2 and WildBlue-1 HCSs have been operation since 2005 and our 2nd generation ViaSat-1 HCS has more capacity than the entire fleets of any other satellite operator. Our 3rd generation ViaSat-2 HCS is in production and will enable us to serve over twice the users as ViaSat-1 at essentially the same invested cost, and our 4th generation HCS that is into its design process to further improve end customer speed, capacity, and interference or AJ performance, as well as affordability.

As shown in Exhibit 7, the result of leadership in satellite broadband and these investments is widening the gap in affordability and fleet capacity. During the period of 2005 through 2016, DoD is reducing its cost of capacity from $248M to $209M/Gbps by increasing its mix of lower cost WGS capacity with that of the higher cost of



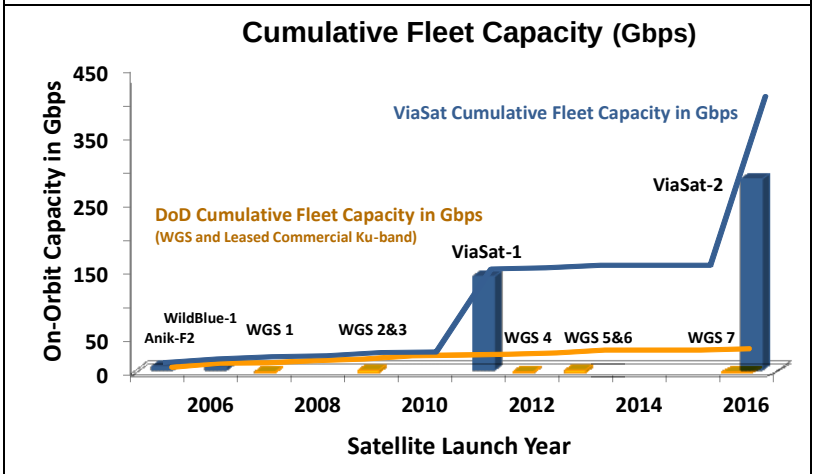


Exhibit 7: In 2005, the DoD and ViaSat had essentially the same on-orbit capacity with DoD's capacity costing 6-times more; in 2016, DoD will have 1/15th the capacity at a cost of over 60-times more.

commercial leased Ku-band capacity. However, by implementing multi-year manufacturing of WGS with constant capacity economics over improving capacity economics with each generation they have implemented 16-times less fleet capacity at an average fleet cost of 60-times greater compared to HTS services.

In order to reduce or stabilize the cost of DoD Satcom, the Satcom architecture, using either military or commercial satellites, needs to be based on these concepts of declining infrastructure cost with each new generation. To achieve this, the requirements on the individual elements of the Satcom architecture must also be based on improved efficiency to lower the overall cost of delivered capacity of the total system. This is the direction of Broadband versus commercial Ku-band FSS communication satellite services.

HCS, with appropriate support by the acquisition processes and authorities, can provide a means to take advantage of lower cost higher performance commercial satellite services thus offering DoD a means to fulfill their ever increasing demand for speed and capacity within current budgets and potential at even a lower budget requirement.

AN END-TO-END PRESPECTIVE IS NECESSARY

The FY15 NDAA designated a single acquisition authority for space strategies, architectures and programs for satellite communications. As a leader in satellite broadband communication, we believe that an end-to-end perspective is essential. This does not mean there needs to be a single authority, but it does mean that the strategy, architecture and solution be considered as an end-to-end system. Many may think this is a subtle argument, they would say satellites are synonyms with satellite communication, but that could not be further from reality. It is the combination of satellites with backhaul, ground entry, and networking that collectively become satellite communications.

DoD is currently organized in a similar manner as the commercial Ku-band broadcast industry. There are satellite owner/operators that wholesale raw bandwidth to service providers. The service providers add backhaul, ground entry, and networking and provide the service to the end-users or customers. In the commercial world the satellite owner/operators are represented by Intelsat, SES, Eutelsat, etc. and DoD counterparts are US AFSPC and DISA for WGS/leased Ku-band bandwidth. The satellite service providers are DIRECTV, Harris CapRock, Artel, etc. and DoD counterparts are PEO C3T, SPAWAR, DISA, AF ESD, SOCOM, JSOC, ARSTRAT, etc. for satellite networking. In this model, if the satellite service provider's network becomes congested or oversubscribed, they must spend more money and buy more capacity from the owner/operator. This is precisely the situation that the DoD is in today. If the warfighter needs more communication, then DoD has to buy more satellites or lease more bandwidth. In this business and acquisition construct, there is no end-to-end performance responsibility, accountability, or life-cycle management perspective. In fact there is actually a disincentive, in that the less capable the satellite or raw bandwidth is, the more satellites or bandwidth the satellite owner/operator can sell to the service provider.

Our thought leadership in satellite broadband is based on our key learning lessons with our first, two satellites, Anik-F2 and WildBlue-1. As our subscribers or number of users increased, we experienced that their individual usage was also increasing. It became immediately obvious that even if we stopped subscriber or user growth, operating our business on satellite architecture with a constant infrastructure cost would cause cost per subscriber to continually increase, earnings to continually decrease, and eventually lead to the failure of the business. This learning experience, which becomes visible to the retail service provider, put ViaSat on the path that our business success is dependent on each successive generation of HCS having better speed and capacity economics. This is

what led us into also being the satellite owner/operator in order to achieve significantly better speed and capacity economics of a cost-per-bit basis with each successive generation of HCS.

Looking back up to Exhibit 7, it is true that DoD has lowered it average cost of capacity. This has been accomplished by changing the mix of commercial leased Ku-band relative to the use of WGS with its more favorable cost of capacity. However, even today the installed base of DoD service providers frustrate this transition to the more affordable WGS capacity and have resisted pilot trials of HCS solutions offering greater speeds, capacity and affordability. In a business and acquisition structure based on individual acquisition authorities, focused on component performance versus end-to-end performance, the cost to update the installed base of end-user equipment trumps new, more affordable, higher speed and capacity networks. With more emphasis on end-to-end performance, end-user equipment can evolve to take advantage of new, more affordable, higher speed and capacity networks.

This is the exact situation that the DBB identified relative to the DoD and should be core to the future DoD space strategies, architectures and programs for satellite communications. Regardless of the projected user growth rates from new missions or echelons or growth in user's applications, using space architectures with a constant infrastructure cost will mandate increasing annual budgets for the future DoD space strategies, architectures and programs for satellite communications.

The need for continual optimization of speed and capacity economics is driven by the Broadband business model. In the Broadband business model, customers or the market demands increasing capacity and speed over time without providing a comparable increase in revenue. As a more obvious terrestrial broadband example, consider the recent introduction of the IPhone 6. Sprint offered customers a new unlimited data plan for the same price, and that very weekend both AT&T and Verizon announced plans doubling their data plans at the same price. This is the construct of Broadband and if these terrestrial wireless providers have not or are not lowering the cost of their infrastructure and operations to generate the capacity required to serve the increased data plans their earnings will be immediately negatively impacted. Instead, as discussed above, they are intently focused growing their networks, growing them more cost effectively, and lowering the cost-per-bit on a delivered basis. And this trade in plan is a method to migrate or evolve the installed base of end-user terminals to operate on the more cost efficient, improved cost-per-bit networks. The DoD cost of the end-user equipment evolution can vary by application and platform, and can be quite considerable relative to changing your smartphone, but in general it is a modem and RF module upgrade based on devices that would leverage higher volume broadband market quantities and price points.

Satellite broadband business has the same construct. In 2005, when we started broadband service on Anik-F2 and WildBlue-1, an acceptable consumer residential service was 5 by 1Mbps rate. Today acceptable is now a 12 by 3 Mbps rate and the FCC just last month redefined new levels of broadband user experience to be a 25 X 3 Mbps rate; all this while the revenue per consumer resident says essentially constant. This essential end-to-end broadband business construct is what fueled the innovation in ViaSat-1 and ViaSat-2 and is defining our next generation of satellites to target 1Tbps of capacity. This is the model for the DoD and what is being highlighted in the FY15 NDAA language.

SUMMARY

ViaSat is a pioneer and industry leader in High Capacity or Frequency-reuse Ka-band satellite architectures. These satellite architectures are specifically designed to provide satellite broadband or two-way broadband

communications and are achieving very affordable, theater-wide simultaneous user capacities many times greater than current DoD Satcom systems either owned or leased. From a resilience perspective these designs improve AJ performance as well as improving speed, capacity, and affordability in a manner that enable multiple or redundant paths to meet current and future DoD broadband requirements while reducing overall cost of ownership. These new satellite architectures provide up to a ***100 fold economic benefit to current DoD practice*** of commercial leased Ku-band and WGS when they are made available in the architecture.

During OEF/OIF, DoD demand for SATCOM grew from 2.3 Gbps in March 2008 to 31.6 Gbps in the summer of 2012. Further, DoD demand for SATCOM is expected to continue for the foreseeable future to support enduring, global C4ISR mission requirements. Unfortunately to date, DoD's existing business practices, acquisition strategies, overly directive technical specifications, and general legislative oversight and appropriations structure all serve to work to view Satcom in segments—satellites, ground entry, user terminals, and networks management—rather than as an integrated end-to-end capability that would evaluate Mbps (capacity) and highly assured Mbps (resilient capacity) to the warfighter.

This intellectual and practical segmentation impedes efforts to understand and take advantage of the value of these newer commercial Satcom capabilities, which focus not only on the technology to deliver bits to the user, but the quality and availability of the bits delivered to the user.

It is imperative first to establish an end-to-end understanding of the significant commercial capacity and affordability improvements already on-orbit and in development that are essential to multi-path capacity for the reconstitution and recovery elements of resilience; and secondly, to enable an understanding of the essential design features of these newer satellite architectures that intrinsically improve the avoidance and robustness elements of resilience; and finally, to empower the much needed acquisition reform required to exploit the significant, yet untapped economic and capacity benefits inherent in these readily available, proven commercial Satcom broadband technologies. In other words, in the private sector, one can only accrue revenue if one delivers what is advertise in terms of the end-user throughput rate, quality, and reliability; in the public sector, the objective must be delivering the highest reliable capacity with appreciable margins to the warfighter in an environment where the they may not really know today what tomorrow's demands will be.

DoD must reform certain acquisition practices and re-focus requirements away from overly directive technical specifications toward acquiring the best broadband capacity by mission. This means telling industry what capacity you want today, what you think you want tomorrow, where, and when; and then establishing metrics to understand and evaluate the value of candidate technologies in terms of the end-to-end proposition and total life cycle cost. To state it simply, if the best[§§] alternative to satisfy the DoD mission already exists in the form of proven commercial Satcom, ***simply subscribe to it*****.** If this best alternative already exists, but doesn't exist in the geographic location yet, enable the ability to subscribe to it when it becomes available. And in geographic locations where commercial Satcom are not likely to ever exist, be prepared to ***replicate or clone the best commercial technologies available*** to rapidly (i.e. typically in three or less years) and affordably (i.e. typically less than $500M to design, build, and launch) field a low risk, proven broadband capability to meet current and future DoD mission requirements.

One path to affordable, resilient broadband capacity is well within reach, and encouraged by the FY15 NDAA Pilot language. DoD could (and should) employ these unprecedented commercial satellite capabilities today,

[§§] Best - Speed, Coverage, Capacity, Resilience, Affordability, Proven (Low Risk)

because the High Capacity Satellites (HCS) are in already on-orbit today providing improved broadband affordability. DoD policies can be changed; and acquisitions processes can be modified in order for the warfighter to leverage these unprecedented Satcom capabilities that are totally responsive to DoD's ever increasing demand for broadband connectivity. It's within the DoD's reach today – all that is needed is the leadership will to do it.

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